

INCREASING PHYSICAL ACTIVITY: PREDICTORS AND EFFECTIVE INTERVENTIONS

Bess H. Marcus

Department of Family and Preventive Medicine

University of California, San Diego

Overview

- Predictors and determinants of physical activity and change in physical activity
- Elements of successful interventions
- Interventions for underserved populations
- Technology and dissemination
- Technology and underserved populations

July 2012

THE LANCET

Physical Activity - July, 2012

www.thelancet.com



"In view of the prevalence, global reach, and health effect of physical inactivity, the issue should be appropriately described as pandemic, with far-reaching health, economic, environmental, and social consequences."

Physical Activity



Physical Activity 2

Correlates of physical activity: why are some people physically active and others not?

Adrian E Bauman, Rodrigo S Reis, James F Sallis, Jonathan CWells, Ruth J F Loos, Brian W Martin, for the Lancet Physical Activity Series Working Group*

Lancet 2012; 380: 258-71

Published Online

July 18, 2012

http://dx.doi.org/10.1016/S0140-6736(12)60735-1

This is the second in a Series of five papers about physical activity

*Members listed at end of paper

Prevention Research

Collaboration, School of Public

Health, Sydney University,

Sydney, NSW, Australia

(Prof A E Bauman PhD); School

of Health and Biosciences,

Pontifícia Universidade

Católica do Paraná, Curitiba,

Brazil (Prof R S Reis PhD);

Federal University of Paraná,

Curitiba, Brazil (Prof R S Reis);

Family and Preventive

Medicine, University of

California San Diego,

San Diego, CA, USA

(Prof J F Sallis PhD); UCL

Institute of Child Health,

University College London,

London, UK

(Prof J CWells PhD); MRC

Epidemiology Unit, Institute

of Metabolic Science,

Addenbrooke's Hospital,

Cambridge, UK

Physical inactivity is an important contributor to non-communicable diseases in countries of high income, and increasingly so in those of low and middle income. Understanding why people are physically active or inactive contributes to evidence-based planning of public health interventions, because effective programmes will target factors known to cause inactivity. Research into correlates (factors associated with activity) or determinants (those with a causal relationship) has burgeoned in the past two decades, but has mostly focused on individual-level factors in high-income countries. It has shown that age, sex, health status, self-efficacy, and motivation are associated with physical activity. Ecological models take a broad view of health behaviour causation, with the social and physical environment included as contributors to physical inactivity, particularly those outside the health sector, such as urban planning, transportation systems, and parks and trails. New areas of determinants research have identified genetic factors contributing to the propensity to be physically active, and evolutionary factors and obesity that might predispose to inactivity, and have explored the longitudinal tracking of physical activity throughout life. An understanding of correlates and determinants, especially in countries of low and middle income, could reduce the effect of future epidemics of inactivity and contribute to effective global prevention of non-communicable diseases.

Introduction

Globally, many adults and children do insufficient physical activity to maintain good health.¹ Furthermore, the population burden of inactivity is unacceptably high.² Although strategies to increase physical activity are being developed,^{3,4} effect sizes are usually small to moderate, and effective interventions are not widely applied. The prevalence of physical activity is slow to improve and is worsening in some countries.⁵ As the global burden of non-communicable diseases increases, risk factors such as physical inactivity become relevant in low-income and middle-income countries, not just in the most developed nations.⁶ Understanding the causes of physical activity

behaviour is essential for development and improvement of public health interventions,⁷ much as aetiological studies of disease provide information about treatments. Of particular interest is how aetiological factors differ between physical activity domains—ie, areas of life in which activity is done (at home, at work, in transport, and in leisure time)—and with country, age, sex, ethnic origin, and socioeconomic status.

One challenge in the interpretation of evidence is that most studies have used cross-sectional designs. This so-called correlates research assesses only statistical association, rather than providing evidence of a causal relationship between factors and physical activity.^{8,9} Longitudinal observational studies and experimental data could identify factors that have strong causal associations with physical activity.⁹ When such factors are identified in studies of aetiological design, they are described as determinants.⁸

Because physical activity is affected by diverse factors, behavioural theories and models are used to guide the selection of variables for study.⁸ Integration of ideas from several theories into an ecological model (including inter-relations between individuals and their social and physical environments) is now common.¹⁰ This approach uses a comprehensive framework to explain physical activity, proposing that determinants at all levels—individual, social, environmental, and policy—are contributors. A key principle is that knowledge about all types of influence can inform development of multilevel interventions to offer the best chance of success.¹⁰ Figure 1 shows a multilevel model of physical activity influences, which guided our classification of variables in this report. The model is ecological because inter-relations between individuals and their social and

Key messages

- Population levels of physical activity participation are low, and improved understanding of why some people are active and others are not is needed
- Some consistent correlates of physical activity are individual-level factors such as age, sex, health status, self-efficacy, and previous physical activity
- Ecological models posit that the physical and social environments—ie, economic conditions, societal norms, urbanisation, industrialisation—are important determinants of physical activity
- Correlates have been less studied in low-income and middle-income countries than in other nations, and although broadly similar to those in high-income countries, they are more focused on the prevalent domains of physical activity in developing countries—ie, correlates of transport and occupational activity
- New research has identified genetics, evolutionary biology, and variation in physical activity behaviour throughout life as important determinants
- Improvement of the research base, with a stronger focus on determinants research (with improved causal inference rather than repetition of cross-sectional correlates studies) will further an understanding of physical activity in populations and interventions designed to increase activity levels

Predictors in Children & Adolescents

Biological/ Demographic	Psychosocial	Cultural/ Social	Behavioral	Environmental
<ul style="list-style-type: none">• Male sex• White ethnicity• Age (negative)	<ul style="list-style-type: none">• Self-efficacy• Perceived behavioral control	<ul style="list-style-type: none">• Family support• General support	<ul style="list-style-type: none">• Previous activity	<ul style="list-style-type: none">• Walkability• Traffic• Land use mix• Residential density• Access to facilities

Not associated: BMI, smoking

Bolded items = most consistent predictors

Predictors in Adults

Biological/ Demographic	Psychosocial	Cultural/Social	Behavioral	Environmental
<ul style="list-style-type: none"> • Male sex • White ethnicity • Age (negative) • Education • BMI • Health status 	<ul style="list-style-type: none"> • Self-efficacy • Intention to exercise • Stages of readiness to change • Perceived effort 	<ul style="list-style-type: none"> • Social support • Cultural & social norms/expectations 	<ul style="list-style-type: none"> • Previous activity • Occupation (job strain, hours) • Self-regulatory skills 	<ul style="list-style-type: none"> • Walkability • Street connectivity • Transportation environment (sidewalks) • Aesthetics • Proximity to facilities

Bolded items = most consistent predictors

Bauman, A.E., Reis, R.S., Sallis, J.F., Wells, J.C., Loos, R.J.F., & Martin, B.W. (2012). Correlates of physical activity: why are some people physically active and others not? *The Lancet*, 380(9383), 258-271.



Physical Activity 3

Evidence-based intervention in physical activity: lessons from around the world

Gregory W Heath, Diana C Parra, Olga L Sarmiento, Lars Bo Andersen, Neville Owen, Shifalika Goenka, Felipe Montes, Ross C Brownson, for the Lancet Physical Activity Series Working Group*

Lancet 2012; 380: 272–81

Published Online

July 18, 2012

[http://dx.doi.org/10.1016/S0140-6736\(12\)60816-2](http://dx.doi.org/10.1016/S0140-6736(12)60816-2)

This is the third in a Series of five papers about physical activity

* Members listed at end of paper

University of Tennessee at Chattanooga and University of Tennessee College of Medicine, Chattanooga, TN, USA

(Prof G W Heath DHC);

Prevention Research Center in St Louis, Brown School of Social Work and School of Medicine Division of Public Health Sciences, Washington University in St Louis, St Louis, MO, USA (D C Parra MPH, Prof R C Brownson PhD); School of Medicine (O L Sarmiento MD) and Department of Industrial Engineering (F Montes MSc), Universidad de los Andes,

Promotion of physical activity is a priority for health agencies. We searched for reviews of physical activity interventions, published between 2000 and 2011, and identified effective, promising, or emerging interventions from around the world. The informational approaches of community-wide and mass media campaigns, and short physical activity messages targeting key community sites are recommended. Behavioural and social approaches are effective, introducing social support for physical activity within communities and worksites, and school-based strategies that encompass physical education, classroom activities, after-school sports, and active transport. Recommended environmental and policy approaches include creation and improvement of access to places for physical activity with informational outreach activities, community-scale and street-scale urban design and land use, active transport policy and practices, and community-wide policies and planning. Thus, many approaches lead to acceptable increases in physical activity among people of various ages, and from different social groups, countries, and communities.

Importance of physical activity promotion

Scientific guidelines issued by various international bodies, national centres and institutes, and professional organisations have documented that regular physical activity protects against coronary heart disease, type 2 diabetes, some cancers, hypertension, obesity, clinical depression, and other chronic disorders.^{1–5} These findings have been reiterated in Lee and colleagues' systematic review of the evidence.⁶ Therefore, the substantial potential benefits of promotion of physical

activity for whole populations and at-risk individuals have become a well established agenda for public health agencies and all types of health-care delivery systems worldwide.⁷

Historically, the primary roles for public health agencies and non-governmental organisations at the international, national, state, and local levels have been to monitor, protect, and promote the public's health.⁸ These functions have been intended to complement contributions of health-care delivery systems and other community sectors to establish effective prevention, control, and management of diseases and chronic disorders.⁹ In the past three decades, the focus of public health has expanded to include initiatives to introduce interventions for injury prevention and control, chronic disease prevention and management, health-promoting public policies, environmental supports for behavioural change, and broad-reach interventions through health communication and media.⁹ Interventions to increase physical activity in whole populations are now prominent in initiatives, with community-based informational, behavioural, social, policy, and environmental approaches.^{10,11}

Physical activity behaviours are affected by factors operating at several levels, which are broadly perceived as personal (such as biological and psychological attributes), social (family, affiliation group, and work factors), and environmental (contexts for different forms of physical activity and policy factors that could determine availability of relevant settings and opportunities).^{12,13} Thus, intersectoral approaches that operate at various levels seem to be the most successful ways to increase physical activity.¹⁴

Community-based health promotion—ie, encouragement of physical activity at national, state or regional, and local levels—can be successful and has greatest reach only through intersectoral collaboration.^{15–18} To plan, promote, and coordinate efforts to increase

Key messages

- Initiatives to promote physical activity can have increased effectiveness when health agencies form partnerships and coordinate efforts with several other organisations: schools; businesses; policy, advocacy, nutrition, recreation, planning, and transport agencies; and health-care organisations
- Effective public communication and informational approaches promoting physical activity include community-wide campaigns, mass media campaigns, and decision prompts encouraging the use of stairs versus lifts and escalators
- Initiatives to increase social support for physical activity within communities, specific neighbourhoods, and worksites can effectively promote physical activity
- Comprehensive school-based strategies encompassing physical education, classroom activities, after-school sports, and active transport can increase physical activity in young people
- Environmental and policy approaches can create or enhance access to places for physical activity with outreach activities; infrastructural initiatives through urban design of land use and planning at community and street scales and active transport policy and practices are effective
- To properly support initiatives for the promotion of physical activity, workforces need to be trained in physical activity and health, core public health disciplines, and methods of intersectoral collaboration
- Although individuals need to be informed and motivated to adopt physical activity, the public health priority should be to ensure that environments are safe and supportive of health and wellbeing

Effective Interventions: What Works?

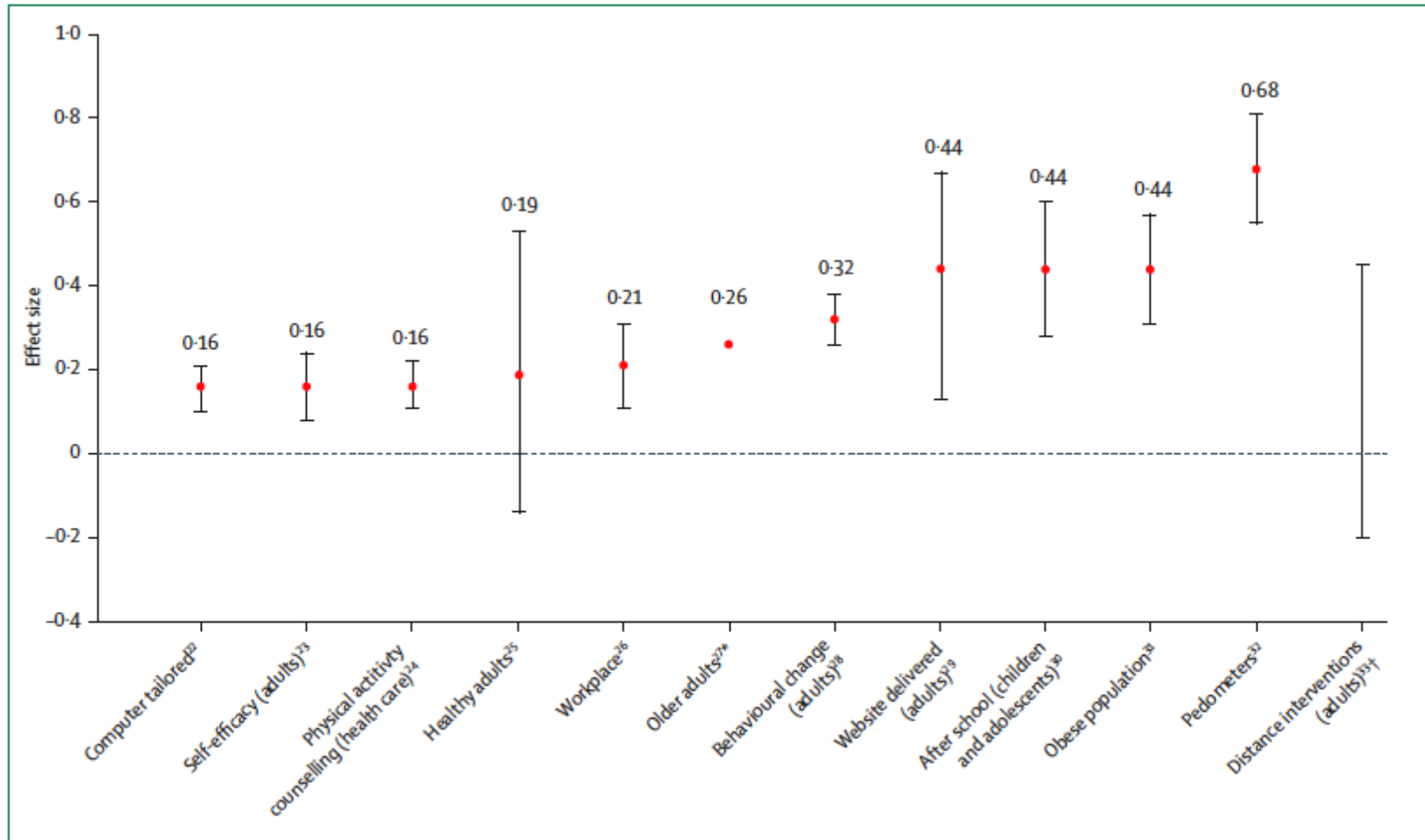


Figure: Mean effect-size estimates from original systematic reviews

All are mean effect size and 95% CIs, unless otherwise indicated. *Index. †Range.

Heath, G.W., Parra, D.C., Sarmiento, O.L., Andersen, L.B., Owen, N., Goenka, S., Montes, F., & Brownson, R.C. (2012). Evidence-based intervention in physical activity: lessons from around the world. *The Lancet* 380(9383), 272-281.

Behavioral & Psychosocial Approaches

□ Individually targeted interventions

- ▣ Adoption of lifestyle physical activity
- ▣ Social support: buddy systems, walking groups, contracts, work-based programs
- ▣ Stages of change: tailor messages to readiness to change
- ▣ Goal setting, monitoring, & self-reward
- ▣ Self-efficacy-based messages

□ Pro's

- ▣ Generally effective (Kahn review, 2002)
- ▣ Cost effective compared to supervised programs
- ▣ More sustainable than supervised programs

□ Con's

- ▣ Wide-scale dissemination may be a challenge
(although communication technologies may help)



Behavioral & Psychosocial Interventions

- Significantly larger effect sizes in studies that included psychosocial elements: **behavioral strategies, instruction, social comparison, time management** (meta-analysis; Williams & French, 2009)
- **Self-Efficacy**
 - Association between changes in self-efficacy and changes in PA, $r = 0.69$ (Williams & French meta-analysis, 2009)
 - Biggest changes in SE produced by social comparison, progress feedback, & vicarious experience (meta-analysis, Ashford et al., 2005)
- **Self-Monitoring**
 - Identified as most important behavior change technique in meta-regression (Mitchie et al., 2009)
- **Social Support**
 - Community and friend support most robust in predicting greater activity (Kahn et al., 2002 review)
- **Individual tailoring**
 - Tailoring to theoretical constructs yields larger effect sizes for behavior change interventions (Noar et al., 2007 meta-analysis)
 - Largest effect sizes seen for tailoring to attitudes, self-efficacy, stage of change, processes of change, and social support
 - Dynamic tailoring more effective than single assessment (Krebs et al., 2010 meta-analysis)

Site-Based Approaches

- **Work-site interventions**
 - ▣ Supportive environment & monitoring system
 - ▣ Simply constructing facilities may be insufficient
- **Community-based classes**
 - ▣ Free/low cost classes offered in underserved communities
 - ▣ Based on effective models in Brazil & Colombia
 - ▣ Cost-effective, sustainable model when led by community members
 - ▣ Does it reach community members who wouldn't otherwise be active?
- **Clinic-based interventions**
 - ▣ Provider-based counseling alone may be ineffective
 - ▣ Increased effectiveness when combined with individual-level intervention components (follow-up, community support, etc.)
- **Pro's**
 - ▣ Potential to be sustainable
 - ▣ Can capitalize on existing social networks
 - ▣ More supervision
 - ▣ Broad reach
- **Con's**
 - ▣ Often does not address psychosocial or behavioral barriers to activity
 - ▣ Can be more costly, lower reach (provider-based)



Community-Wide Campaigns

□ Mass media campaigns

- Mixed evidence for determining effectiveness
- May need to be combined with more targeted approaches
- Pro's: high reach, some have been effective (e.g., VERB)
- Con's: high absolute cost (though potentially less cost per person), some less effective

□ Point-of-Decision Prompts

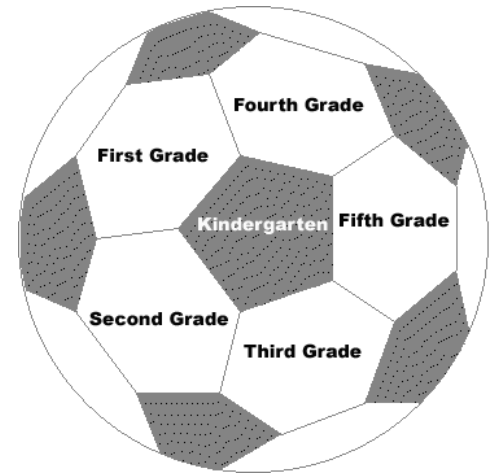
- Generally successful when prompts are population-specific
- Pro's: high reach, very low cost
- Con's: actual health benefits may be minimal





School-Based Interventions

- **Physical education classes consistently effective**
- **Effective elements**
 - ▣ Increased number of classes
 - ▣ Improved quality of classes
 - ▣ Increased PA during breaks
 - ▣ Capacity building & self-training
 - ▣ Improved curricula
 - ▣ Provision of equipment
 - ▣ Adjustment to target populations
- **Participation in PE increases PA, improves fitness, reduces CVD risk factors**



Environmental Modification

- **Is environmental modification sufficient to increase physical activity in the community?**
 - Increased use of facilities = increased PA? (Or just a new location?)
 - Many studies show increased use, but no individual pre-post data
- **Facility enhancement not *always* effective**
 - Improvement to LA parks followed by *decline* in use; attributed to fewer organized activities (Cohen et al., 2009)
 - Those using a new urban trail in Chapel Hill did *not* report significant increases in leisure PA or walking for transportation (Evensen et al., 2005)
 - Refurbished senior center saw significantly less use after improvements, fewer classes scheduled (Cohen et al., 2009)
- **Effective modifications**
 - Park size, & organized activities (Cohen et al., 2010 review)
 - Facilitators of active transport
 - Active commuting for children (Faulkner et al., 2009 review)
 - Enhanced public transportation for adults (Durand et al., 2011 review)
 - Neighborhood walkability

Environmental Modification + Psychosocial Interventions

□ **Who benefits from environmental change?**

- Activity-friendly environments (Sallis et al., 2012)
 - +0-28 min/week for those with low social support & self-efficacy
 - +30-59 min/week for those with high social support & self-efficacy
- Walking for transport = interaction of walkability, social support, self-efficacy, and barriers

□ **Psychosocial interventions + environmental change**

- Few studies have attempted both
- May be necessary combination to change communities

□ **Combined approaches**

- Ciclovía, Colombia
 - Remove environmental barriers to activity (cars), mass media promotion of campaign, community education, incentives for compliance at individual, corporate, & local levels
- Trail construction in Missouri (Brownson et al., 2000)
 - Focus groups, community volunteer-led construction and maintenance, individually-tailored reports available, walking groups organized
 - 55% of users reported increasing activity; greatest change among women and those with less education

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STRATEGY 7

Encourage local, state, and federal public health agencies and key stakeholders from the eight sectors to integrate into their physical activity plans and programs Web- and new media-based physical activity interventions that are supported by evidence.

TACTICS

- Test the dissemination of evidence-based media interventions and identify those with the greatest likelihood of population reach and impact.
- Fund and Implement these interventions, prioritizing large population groups.

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STRATEGY 8

Expand the definition of media for mediated interventions to include new and emerging technologies such as global positioning systems, video gaming, and other technologies. Identify funding for research to develop evidence that supports or opposes the use of existing and emerging technologies for increasing physical activity.

TACTICS

- Encourage technology companies, such as cellular phone manufacturers and service providers, global positioning systems manufacturers, and health-e games manufacturers, to research and develop products and applications that promote and track physical activity.
- Support research on e-health marketing interventions conducted by universities in collaboration with industry, working together to promote products that demonstrate the most promise.

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Physical Activity 4

The implications of megatrends in information and communication technology and transportation for changes in global physical activity

Michael Pratt, Olga L Samiento, Felipe Montes, David Ogilvie, Bess H Marais, Lilian G Perez, Ross C Brownson, for the Lancet Physical Activity Series Working Group*

Lancet 2012; 380: 282-93

Published Online

July 18, 2012

[http://dx.doi.org/10.1016/S0140-6736\(12\)60736-3](http://dx.doi.org/10.1016/S0140-6736(12)60736-3)

DOI:10.1016/S0140-6736(12)60736-3

This is the fourth in a Series of five papers about physical activity

*Members listed at end of paper

National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, GA, USA (M Pratt MD)

L G Perez MPH, School of Medicine (O L Samiento MD)

M Pratt, and Department of Industrial Engineering (F Montes MSc), Universidad de

Physical inactivity accounts for more than 3 million deaths per year, most from non-communicable diseases in low-income and middle-income countries. We used reviews of physical activity interventions and a simulation model to examine how megatrends in information and communication technology and transportation directly and indirectly affect levels of physical activity across countries of low, middle, and high income. The model suggested that the direct and potentiating effects of information and communication technology, especially mobile phones, are nearly equal in magnitude to the mean effects of planned physical activity interventions. The greatest potential to increase population physical activity might thus be in creation of synergistic policies in sectors outside health including communication and transportation. However, there remains a glaring mismatch between where studies on physical activity interventions are undertaken and where the potential lies in low-income and middle-income countries for population-level effects that will truly affect global health.

Introduction

Non-communicable diseases account for 60% of all deaths globally, and 80% of these deaths occur in low-income and middle-income countries.¹ An epidemiological transition from a burden of disease dominated by communicable

diseases to one dominated by non-communicable diseases² is now occurring in countries with low and middle incomes as it has previously in those with high incomes.³ Physical inactivity is a major risk factor for non-communicable diseases, accounting for an estimated 3·2 million deaths per year.⁴ Most of these deaths, as well as the huge burden of morbidity and disability attributable to physical inactivity, take place in countries with low and middle incomes. Public health attention to physical inactivity has evolved rapidly in the past decade, as shown by the 2004 WHO global strategy on diet, physical activity, and health,⁵ the 2010 WHO global recommendations on physical activity for health,⁶ and the central role of physical activity in the 2009 WHO action plan for the global strategy for the prevention and control of non-communicable diseases⁷ and the UN General Assembly summit on non-communicable diseases.⁸

A major goal for public health is to identify evidence-based interventions to promote physical activity in populations. To do so, several types of evidence are needed.⁹⁻¹¹ Type 1 evidence defines the causes of disease due to physical inactivity and the magnitude, severity, and preventability of inactivity. Type 2 evidence describes the effectiveness of specific interventions that address physical inactivity. Type 2 evidence (summarised in the Cochrane Library, Community Guide reviews, or UK National Institute for Health and Clinical Excellence [NICE] guidance) identifies effective interventions for promotion of physical activity.^{12,13} Type 3 evidence shows in what contexts interventions are implemented and how they can be adapted from one population to another (eg, from a high-income country to those with low and middle incomes).¹⁴ Most intervention studies have not been done in countries with low and middle incomes

Key messages

- Non-communicable diseases account for 60% of deaths globally, and 80% of these deaths occur in low-income or middle-income countries
- Physical inactivity is one of the major risk factors for non-communicable diseases, accounting for an estimated 3·2 million deaths per year
- The challenges and opportunities in prevention of non-communicable diseases show several important megatrends—major forces in societal development that are likely to shape people's lives in the next 10–15 years
- Information and communication technologies in the form of internet and mobile phone access have grown enormously during the past decade; these technologies have the potential to affect physical activity
- Trends in transportation, including the growth in ownership and use of private cars and improved and well integrated public transit systems, have the potential to both negatively and positively affect participation in physical activity, especially walking
- On the basis of a review of publications about physical activity interventions, we modelled the effects of megatrends in internet access, mobile phone access, and car ownership on physical activity
- The direct and potentiating effects of mobile phone technology on physical activity in middle-income and upper-income countries are similar in size to the mean effects of planned physical activity interventions in community and clinical settings
- The greatest potential for increasing population physical activity might be in the creation of supportive policies in sectors outside health (transportation, urban planning, and communication)
- There is a glaring mismatch between where the studies of physical activity interventions have been done and where the potential lies for population-level effects that will truly affect global health (low-income and middle-income countries)

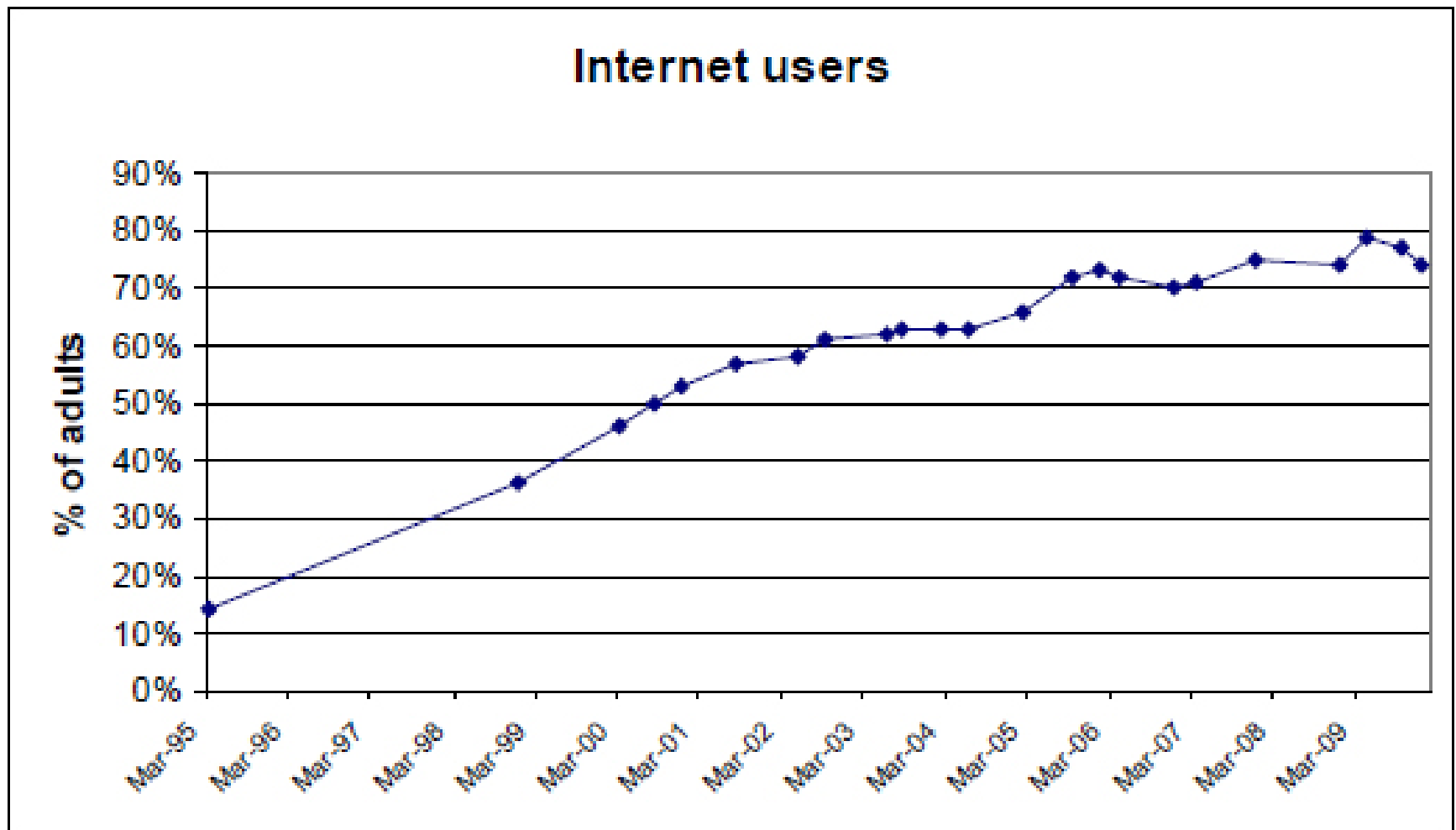
Technology and Dissemination

- ❑ Reduces need for site-based interventions
- ❑ Possibility of wide-spread dissemination
- ❑ Interventions need to keep up with and be consistent with changing lifestyles



Pratt, M., Sarmiento, O.L., Montes, F. Ogilvie, D., Marcus, B.H., Perez, L.G., & Brownson, R.C. (2012). The implications of megatrends in information and communication technology and transportation for changes in global physical activity. *The Lancet*, 380(9383), 282-293.

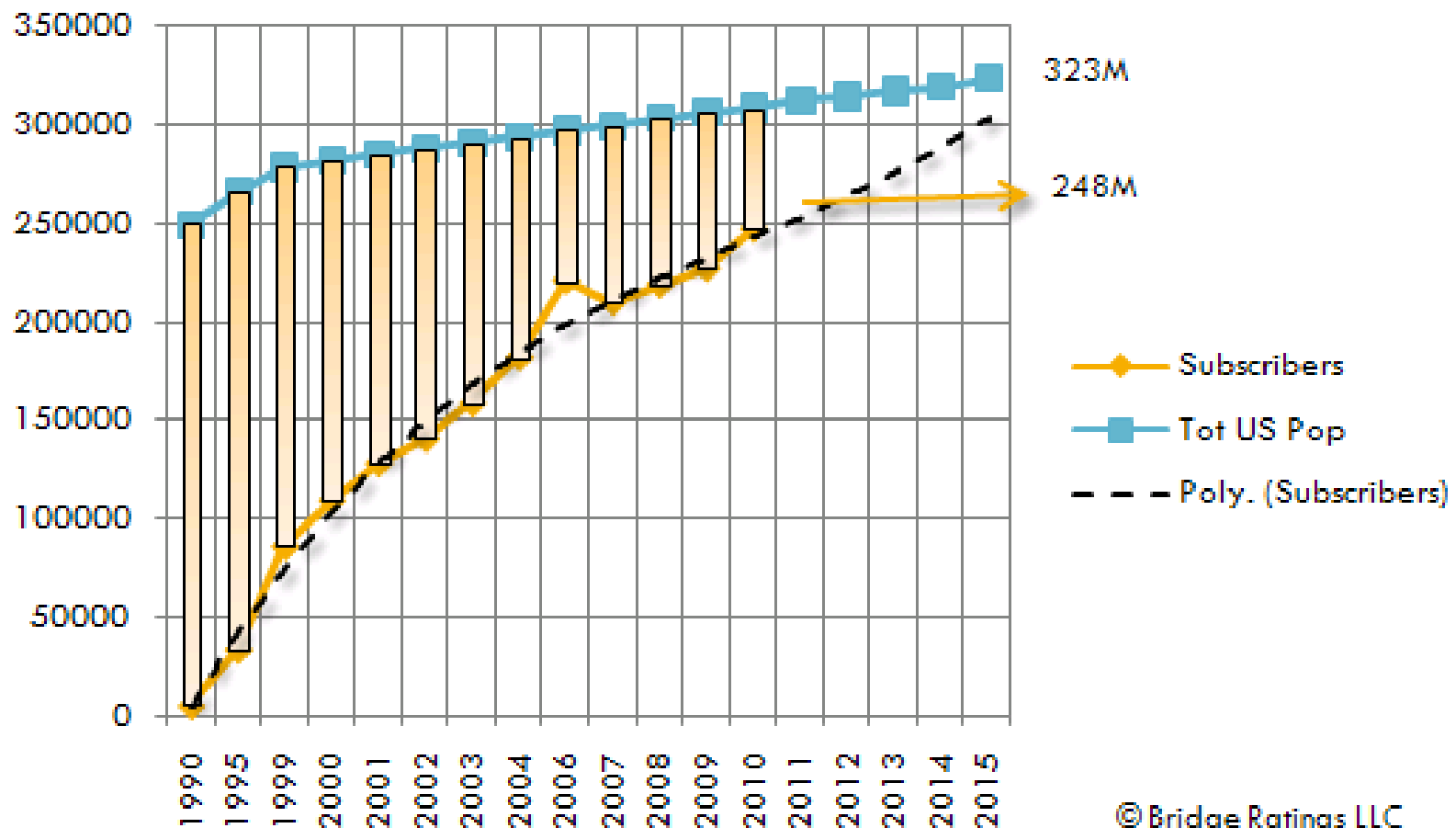
Internet Users in the U.S.



Source: Surveys by The Pew Research Center's Internet & American Life Project and the Pew Research Center for The People & The Press.

Cell Phone Use in U.S.

U.S. Cell Phone Subscriber Growth 1990-2015



How to Best Use Technology?

- **Should be combined with theory-based interventions**
 - “Overall, web-based interventions show small positive effects. However, on the basis of our review, few web-based physical activity trials have used program features specifically matched to theoretical constructs known to result in changes in physical activity behavior and likely to increase effectiveness.”

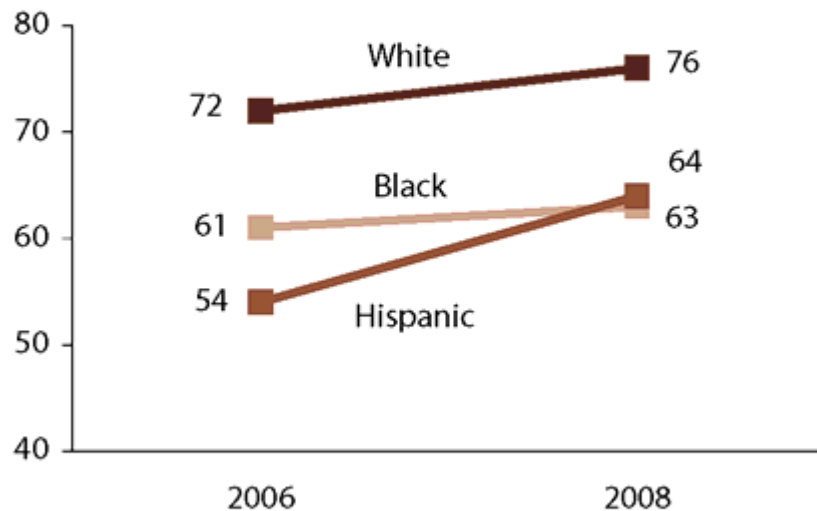


Technology and Underserved Populations

- **Using technology to reduce disparities**
- **“The digital divide” is narrowing**
 - ▣ Exists somewhat for internet, not for mobile phones
- **Globally, low SES populations are early adopters of mobile phones**
 - ▣ In the U.S., higher use in low SES groups and minorities

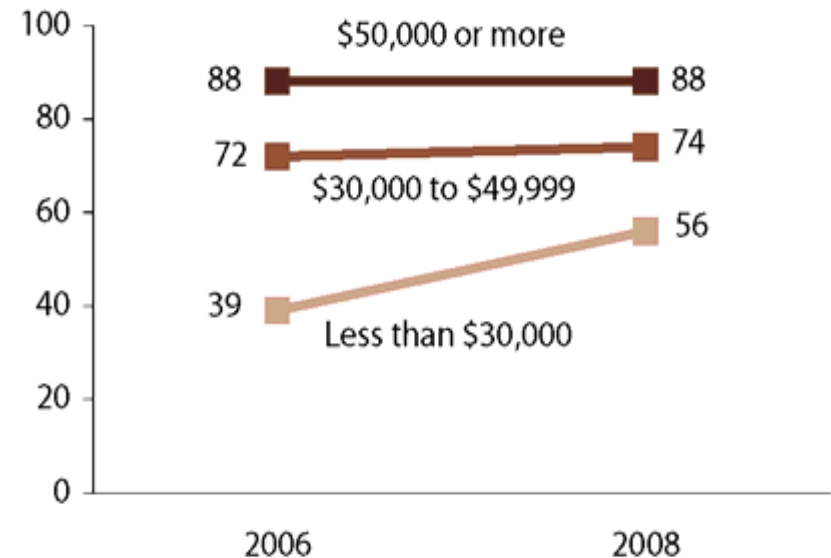
Internet Use in Minorities

Figure 1
Internet Use, by Race and Ethnicity,
2006 and 2008
(%)



Note: Includes adults ages 18 and older.
Source: Pew Hispanic Center and Pew Internet & American Life Project surveys

Figure 6
Latino Internet Use, by Household Income,
2006 and 2008
(%)



Source: Pew Hispanic Center surveys

Mobile Phone Use by Race/Ethnicity

US Consumers Who Have Used the Internet on a Mobile Device, by Race/Ethnicity, 2007 & 2009 (% of respondents in each group)

	White		Black		Hispanic	
	2007	2009	2007	2009	2007	2009
Those who have ever gone online with a handheld device	21%	28%	29%	48%	38%	47%
Those who on a typical day go online with a handheld device	9%	17%	12%	29%	18%	29%
% with cellphones	75%	84%	73%	83%	84%	89%

Note: ages 18+

Source: Pew Internet & American Life Project, "Wireless Internet Use," July 22, 2009

Low SES SMS Interventions

- **WelTelKenya Project (Lester et al., 2010)**
 - Newly infected HIV patients
 - 76% lived on $\leq \$5/\text{day}$, 87% owned a mobile phone
 - Weekly reminder text messages
 - Improved adherence to anti-retroviral therapy
- **MobileMums (Fjeldsoe et al., 2009)**
 - Post-partum women from low SES neighborhoods
 - Received regular text messages with behavioral & cognitive strategies for increasing physical activity
 - Increased minutes of walking for exercise, and frequency of MVPA and walking

Thank You!

